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Studies on nerve regrowth and selective nerve-muscle connections in fishes.

Section and regeneration of the main oculomotor nerve trunk in the cichlid fish Astronotus ocellatus is followed by restoration of normal function. That the excellent motor recovery obtained may be ascribed to a process of selective regrowth and reconnection, rather than to respecification of mis-regenerated fibers, has been indicated in a series of experiments involving surgical insertion of sectioned nerve branches into denervated foreign muscles within the same system. Regenerating nerves established transmission connections with the foreign muscles, but did not acquire the timing of discharge appropriate to those muscles.

Further evidence concerning selectivity during regrowth has been obtained in a series of experiments involving competitive reinnervation. Severed nerve branches were reinserted into their own muscles simultaneously with nerve branches from other muscles; or their re-insertion was delayed in order to allow the foreign nerves to establish connections with the muscles first. In the case of simultaneous insertion the function of the original nerve was clearly dominant, with no observable influence of the foreign nerve, while in the case of delayed re-innervation by the original nerve, the latter was able to "recapture" its muscle even after transmissive connections had been established by the foreign nerve. The results point to the existence of specific properties of some kind in the muscles and regenerating nerves of the oculomotor system that favor the formation of normal over abnormal nerve-muscle connections.

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